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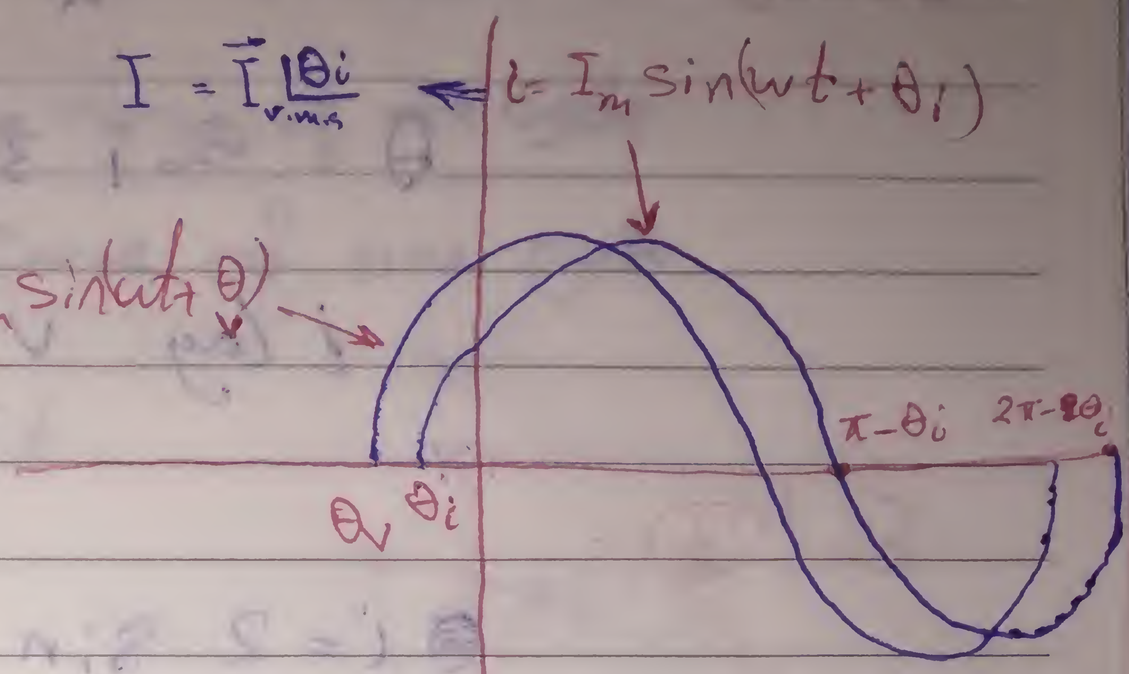
* phase shift

$I = \vec{I}_{\text{r.m.s}} \angle\theta_i \leftarrow i = I_m \sin(\omega t + \theta_i)$

$V = \vec{V}_{\text{r.m.s}} = V \angle\theta_v \leftarrow v = V_m \sin(\omega t + \theta)$ (phasor form)



$* \theta \equiv \theta_v - \theta_i$

(الزاوية بين i, v)

θ angle

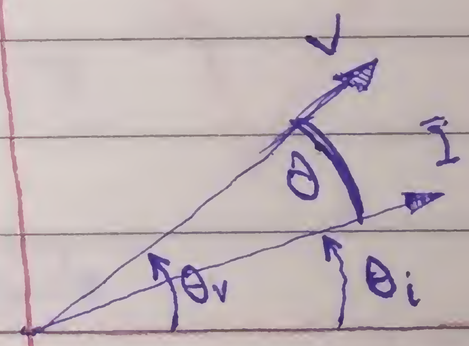
find the phase shift

1. $v = 100 \sin(\omega t + 40), \; i = 10 \sin(\omega t + 90)$
2. $v = 15 \sin(\omega t + 50), \; i = 1 \sin(\omega t - 30)$
3. $v = 30 \sin(\omega t - 10), \; i = 2 \cos(\omega t + 30)$
4. $v = 20 \sin(\omega t + 10), \; i = -5 \sin(\omega t + 30)$
5. $v = 30 \sin(\omega t - 180), \; i = -5 \cos(\omega t - 30)$

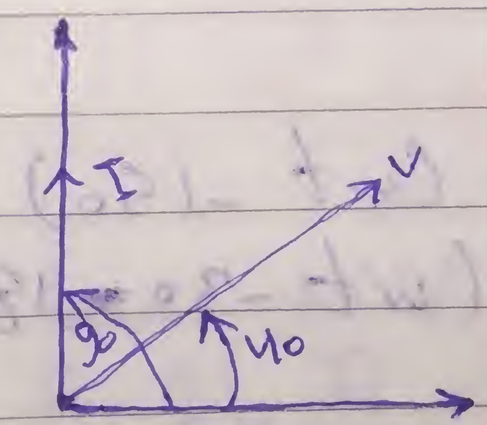
v lead i by θ
or
i lag v by θ

Sol ②. $\theta_v = 40, \; \theta_i = 90$

$\theta = \theta_v - \theta_i = 40 - 90 = -50$

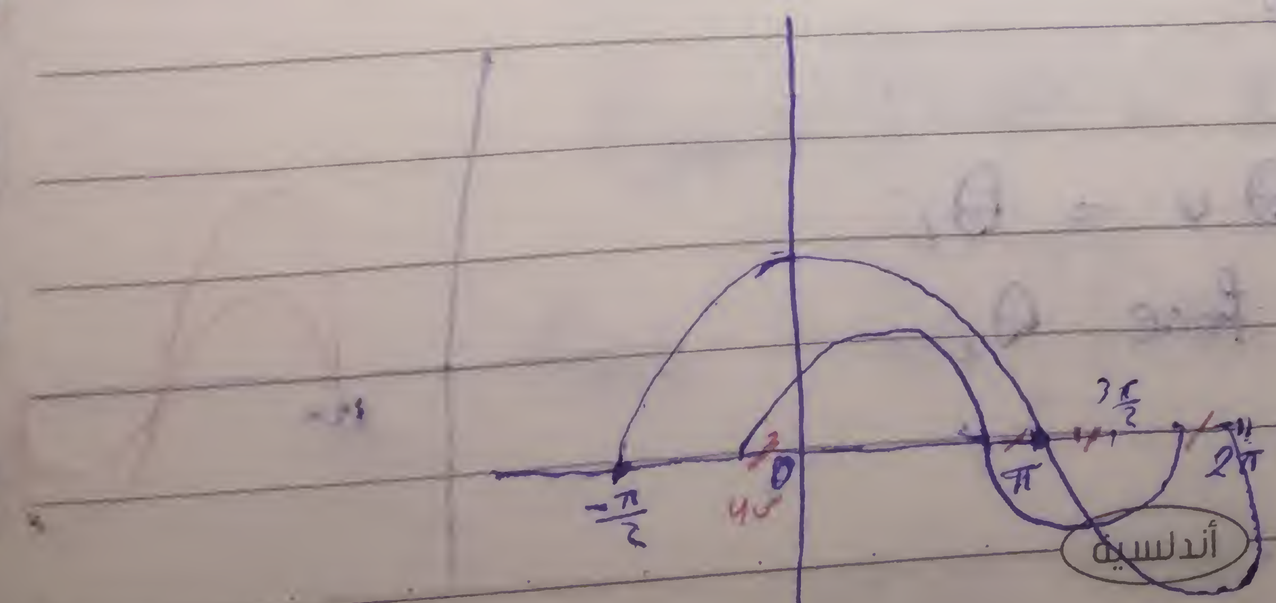


I lead V by 50°



نلاحظ نرسم بـ scale لو كان مش معلوم

"Phasor Digraph"



$\cos\omega t = \sin(\omega t + 90)$

$\sin\omega t = \cos(\omega t - 90)$

$\sin(-\theta) = -\sin\theta$

$\cos(-\theta) = \cos\theta$

$-\sin\theta = \sin(\theta \pm 180)$

$-\cos\theta = \cos(\theta \pm 180)$

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Sol ②:- $\theta v = 5^\circ$ & $\theta i = -3^\circ$

$\theta = 5^\circ + 3^\circ = 8^\circ$

i lag v by 8°

Sol ③:-

$i = 2 \sin(\omega t + 90^\circ + 10)$

$\theta v = -10$

$\theta i = 100$

$\theta = -110$

i lead v by 110

Sol ④:-

اى كميتا زاوية صفرة

$i = \sin(\omega t + 30 - 180)$

$\theta v = 10$, $\theta i = -150$

$\theta = -160$

V lead i 160°

Sol ⑤:-

$V = 30 \sin(\omega t - 150)$

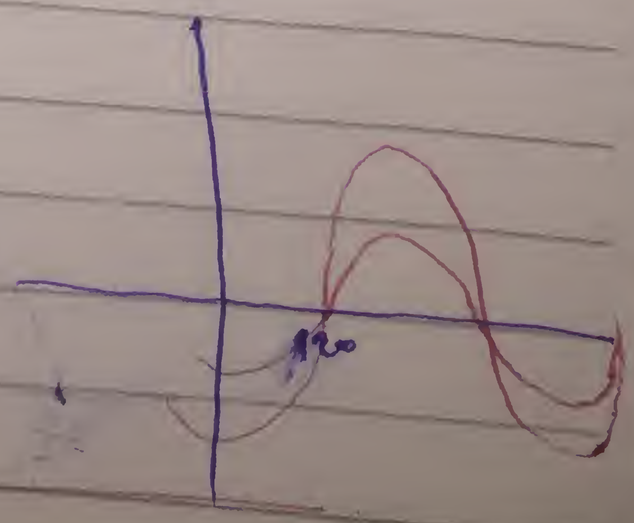
$i = 5 \cos(\omega t - 30 - 180 + 90)$

$\theta v = -120$

$\theta i = -180$

$\therefore \theta v = \theta i$

$\therefore \theta v$ face θi



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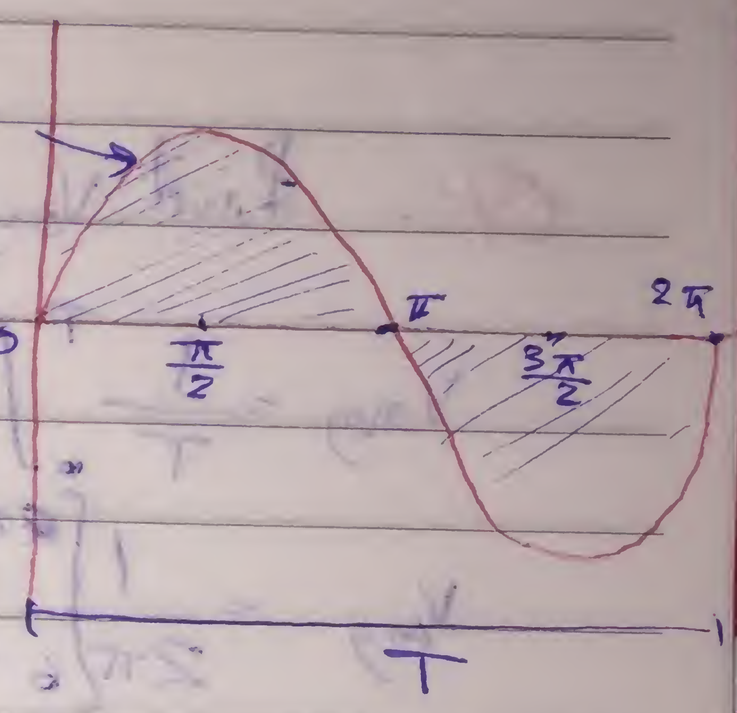
* Average value or Mean value :-

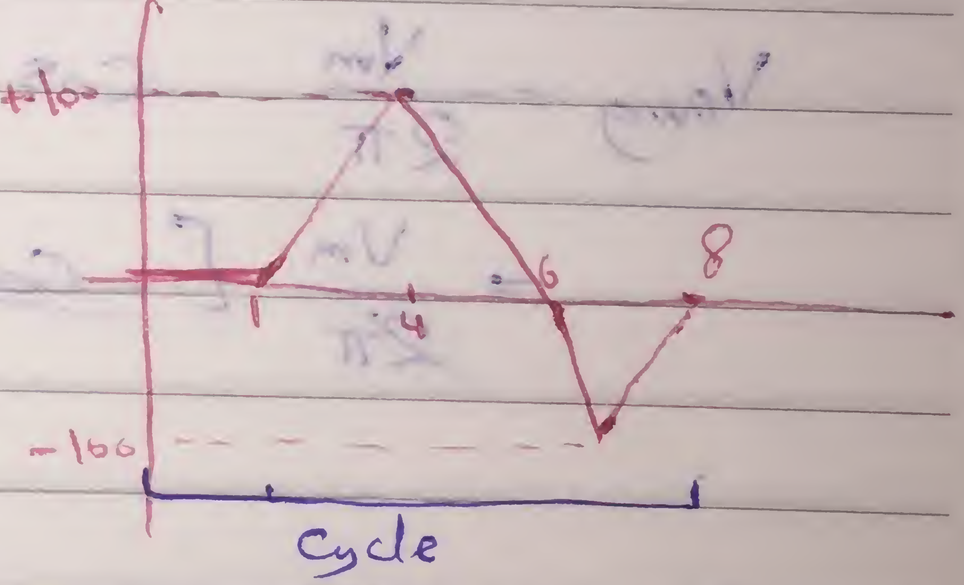
$$V_{AVg} = \frac{\sum \text{area under the curve of one cycle}}{\text{Length of curve of one cycle}}$$

$$V_{avg} = \frac{1}{T}\int_0^T v(t)\,dt$$

$$= \frac{1}{2\pi}\int_0^{2\pi} V_m \sin \omega t \, d\omega t$$



ex: Find the V_{avg}.



$$V_{avg} = \frac{\frac{5}{2} \times 100 - \frac{2}{3} \times 100}{7}$$

* Effective value or Root mean Square value:

V_{eff} or $V_{r.m.s}$ or V

$I_{dc} \Longrightarrow P = I_{dc}^2 R$

$$P_{(t)} = i^2 R = I_m^2 \sin^2(\omega t) \cdot R$$

$$P_{avg} = \frac{1}{T}\int_0^T P(t)\,dt = \frac{1}{T}\int_0^T I_{dc}^2 R\,dt$$

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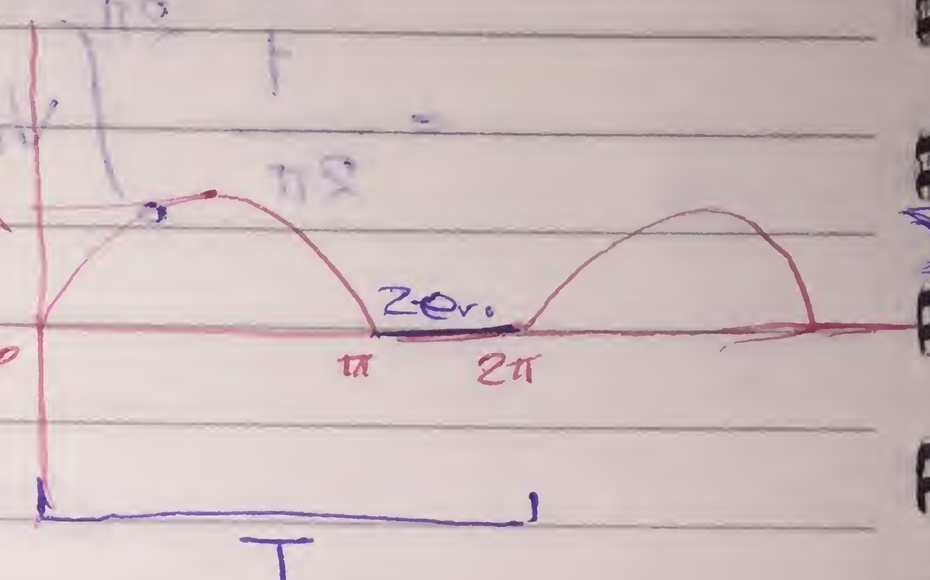
$$I_{eff} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\,dt}$$

$$V_{eff} = V_{r.m.s} = V = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

Ex:- find V_{avg} & V_{eff}

$$V_{avg} = \frac{1}{T}\int_0^T v(t)\,dt$$

$$V_{avg} = \frac{1}{2\pi}\int_0^{\pi} (V_m \sin \omega t\, d\omega t)$$



$$V_{avg} = \frac{V_m}{2\pi} -\cos \omega t \Big|_0^{\pi}$$

$$= \frac{V_m}{2\pi}\left[-\cos\pi + \cos 0\right] = \frac{V_m}{\pi}$$

$$V_{eff} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} V_m^2 \sin^2(\omega t)\,d\omega t}$$

$$= \sqrt{\frac{V_m^2}{2\pi}\int_0^{\pi} \sin^2(\omega t)}$$

$$= \sqrt{\frac{V_{m2}}{2\pi}\int_0^{\pi} (1 - \cos 2\omega t)\,d\omega t}$$

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$\frac{V_{max}}{\sqrt{2}}$

Report: Sin wave find V_{eff} V_{avg}

(2016)